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## **Evaluation of Driving Performance at Three Levels of Driving Experience By Means of the Auto Trainer\***

By ROBERT F. MORRISON

Driver education is one of the most generally accepted methods being advocated for reducing the annual motor vehicle fatality toll. Lack of teachers and facilities limit the number of students that can be taught by the schools. One approach for teaching driving skills is by the use of simulated driving apparatus used in the classroom or laboratory. An example of these devices is the Auto Trainer developed by the American Automobile Association.

A study by Lauer, Allgaier, Siebrecht and Suhr (1) shows that the Auto Trainer yields sufficiently reliable scores to warrant its use as an educational instrument in a classroom situation, but that the total time score varied with the experience of the different experimental groups.

This finding was the basis for the main hypothesis of the current study. Positively stated, it is that the steering, error, movement, response time and total time scores, as subscores on the Auto Trainer, are functions of driving experience and/or aptitude in driving. More specifically, total time scores are a function of training behind-the-wheel.

### **METHOD, APPARATUS AND PROCEDURE**

#### **Subjects**

The subjects used in this study were 66 students enrolled at Iowa State College or in learning-to-drive courses. They were selected to represent three levels of driving experience. The beginning group (B) consisted of 25 students enrolled in the beginning driver education course, each with a minimum of six periods of instruction. There were nine male and sixteen female subjects in this sample.

The average driver group (A) was picked through systematic randomization from the undergraduate student population at Iowa State College. Only those having driven three years or who had covered approximately 10,000 miles were used. This sample comprised an N of 25, seventeen male and eight female subjects.

The third group (I) consisted of sixteen male students, graduate and undergraduate, at Iowa State College who were teaching driv-

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\*Project of AAA on driver education under the direction of Dr. A. R. Lauer in the Driving Research Laboratory. The author is indebted to Dr. R. B. McHugh for assistance in setting up the design for statistical analysis.

ing or learning to teach beginner driver education classes. The data were calculated from the total of 66 subjects as described.

### **Apparatus**

The apparatus consisted of a model B Auto Trainer with slight alterations for experimental control.

The Auto Trainer is a simulated teaching device which records (a) steering score (the ability of the subject to stay on the road), (b) errors (mistakes made by the subject in driving procedure, staying on the designated route, following directions, asking instructions, and responding to the red light), (c) movements (each brake, clutch, accelerator, and steering movement of the controls), (d) stop-light response time (the average time for the subject to respond to five presentations of a red light), and (e) total time (the amount of time for the subject to finish the series of twelve instructions—an amount limit test.) Additional equipment consisted of a seat designed to be adjustable and a light placed over the instructions and roadway to serve as a constant light source. Otherwise the model B Auto Trainer designed by the American Automobile Association was used as built.

### **Experimental procedure**

The same experimental procedure was followed as in the study by Lauer and others (1). Standard instructions and data sheets were used in the study as described (*ibid*).

The subject was first allowed to adjust the seat until he was comfortable. Then the instructions were read by the experimenter and any questions of the subject were answered. Practice was next given to acquaint the subject with the steering, clutch, and other mechanical working parts of the Auto Trainer. Without benefit of the additional instructions or test runs, the subject was allowed to practice until he felt confident about undertaking the directions and apparatus. Questions which the subject might have were then answered, after which the two test runs were made in succession. The practice and tests were conducted with only the subject and experimenter present.

### **RESULTS**

Point triserial and point biserial correlations were computed from the data between various subscores and the three levels of experience according to the formulas given by Wert, Neidt, and Ahmann (3). Student's "t" distribution was used to determine the confidence levels of the coefficients obtained.

The point triserial correlations for steering, error, and total time scores were consistently significant for both trials as shown in Table 1. The point triserial  $r$ 's are unreflected but are all in the expected direction thus lending support to the hypothesis being tested. A

**Table 1**  
Point Triserial Correlation of Auto Trainer Performance Subscores with Driving Experience (N = 66)  
Level of Performance

Performance Score	$M_B$		$M_A$		$M_I$		$rp_{tri}^*$		$P$	
	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2
Steering	82.40	87.44	101.48	96.28	98.44	96.63	.343	.269	<.01	<.05
Errors	12.32	10.24	8.44	4.24	7.44	5.81	-.414	-.305	<.01	<.02
Movements	142.40	143.16	129.63	138.76	129.62	130.19	-.108	-.193	>.05	>.05
Response time	1.95	1.19	2.04	1.05	1.31	1.21	-.091	-.006	>.05	>.05
Total time	7.76	6.84	5.85	4.96	4.97	4.59	-.588	-.632	<.01	<.01

Legend for Table 1:  $M_B$  = mean of beginner driver performance subscores.  
 $M_A$  = mean of average driver performance subscores.  
 $M_I$  = mean of the instructors driving performance subscores.  
 $rp_{tri}$  = point triserial r.  
 $P$  = probability.

\*The point triserial r's are not reflected. It would be expected from previous studies that experience would vary directly with steering subscores and inversely with errors, movements, response time and total time.

substantial relationship was shown between experience levels and performance on the Auto Trainer.

Another type of analysis was made since the means for instructors' (I) and average drivers' (A) performance scores were consistently close together (see Table 2) and only the mean for the beginners' performance scores (B) seemed to differ. Point biserial correlations were computed between experience and performance for (A) and (I). Only one of these correlations was significant at the five per cent level. As shown by Sakoda, Cohen and Beall (2), this single exception could be a function of massed procedures which might result in the probability of obtaining one or more  $r$ 's at significant levels above chance. Of the 30 computed correlations only one was found to differ from the trend indicated by the other 29.

Table 2

Point Biserial Correlations of Auto Trainer Performance Subscores for the Average Driver and Instructor (N = 41)

Performance Score	Level of Performance							
	M <sub>A</sub>		M <sub>I</sub>		rpbis		P	
	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2
Steering	101.48	96.28	98.44	96.63	-.091	.012	>.05	>.05
Errors	8.44	4.24	7.44	5.81	-.125	.262	>.05	>.05
Movements	129.63	138.76	129.62	130.19	-.238	-.180	>.05	>.05
Response time	2.04	1.05	1.31	1.21	-.186	.177	>.05	>.05
Total time	5.85	4.96	4.97	4.59	-.328	-.219	<.05	>.05

Legend for Table 2: Same as for Table 1 except pbis = point biserial.

Since it appears that the instructors (I) compare very closely with average drivers (A) in experience and performance it would be expected that the rpbis in this table would be lower than in Tables 1 or 3.

Table 3

Point Biserial Correlations of Auto Trainer Performance Between Lesser (B) and More (A & I) Experienced Groups (N = 66)

Performance Score	Level of Performance							
	M <sub>B</sub>		M <sub>A&amp;I</sub>		rpbis		P	
	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2
Steering	82.40	87.44	100.29	96.41	.429	.306	<.01	<.02
Errors	12.32	10.24	8.05	4.85	-.430	-.423	<.01	<.01
Movements	142.40	143.16	139.98	135.41	-.034	-.152	>.05	>.05
Response time	1.95	1.19	1.75	1.11	-.041	-.064	>.05	>.05
Total time	7.76	6.84	5.50	4.82	-.584	-.676	<.01	<.01

Legend for Table 3: Same as for Table 1 except pbis = point biserial.

The scores for (a) steering, (b) errors and (c) total time seem to show very consistent correlations. Since errors (b) seem to be a function of the examiner it would seem desirable to use only steering and total time as predictors of experience or road performance.

In general, the results are in agreement with other unpublished studies of the laboratory that instructors of driver education are not better than the average run of licensed drivers with similar experience. This should be an incentive for instructors to try to improve their driving efficiency.

In the third phase of the analysis point biserial correlations were also computed for the performance scores with experience of beginners (B) and the combined more-experienced group of instructors (I) and average drivers (A).

These correlations have significance levels which agree with those from Table 1.

### DISCUSSION

In general the results corroborate the suggestions made by the findings of Lauer and others (1) that total time scores on the model B Auto Trainer are inversely related to the amount of experience of the subject. Steering scores show a direct relationship to experience while error scores, response time and movement scores give  $r$ 's in the expected direction. The later two were not substantial coefficients.

It is possible that the error score may be a function of inter-experimenter variation because of its subjective nature. Previous studies (ibid) have suggested this source of variance in error scores.

Steering and total time scores of performance are indicated to be functions of the level of driving experience, while error, movement and response scores are not. The confidence levels are shown in the respective tables.

The correlations between experience of average drivers and instructors were mostly not significant. The instructors were chosen as a third group because of their demonstrated interest in teaching driver education. The results indicate that the driving skills of instructors on the Auto Trainer are not significantly different from those of the average driver.

The sampling method was not entirely random and the three groups were not selected to control certain extraneous variables such as age and sex. Therefore the results cannot be applied generally to populations of beginning drivers, average drivers, and driver education instructors but must be interpreted in the light of the present study. They do agree closely with similar data previously analyzed.

### SUMMARY AND CONCLUSIONS

Three samples were taken from groups of beginning drivers, average drivers, and driver education instructors at Iowa State College. Each subject was given two test runs on the model B Auto Trainer to obtain performance scores of steering, errors, movements,

response time and total time. Correlations were calculated between the scores and experience levels by multi-serial techniques.

Within limitations of the study as set up and described the following conclusions are drawn:

1. Significant correlations in the expected direction between two levels of driving experience with steering, error, and total time scores of performance on the model B Auto Trainer corroborate the hypothesis that steering and total time scores are functions of driving experience.

2. This hypothesis was not affirmed in all cases with respect to the error scores.

3. There is evidence that the level of performance for the average driver and the driver education instructors on the model B Auto Trainer is not significantly different from the groups used in this experiment.

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